

1       **52279/GSL/W277**

WHAT IS CLAIMED IS:

1.     An underground drilling system comprising:
- 5       a wellbore in an underground formation;
- a fixed tubular casing installed in the wellbore;
- a rotary drill pipe extending through the casing and having O.D. spaced from an I.D. of the casing or wellbore during normal drilling operations;
- 10       a protective sleeve mounted around the drill pipe having a hardness in the range of 75 to 123 Rockwell R;
- thrust bearing collars rigidly affixed to the drill pipe above and below the sleeve for maintaining the sleeve in a fixed axially position on the drill pipe;
- 15       the protective sleeve mounted to the drill pipe via an internal sleeve I.D. configuration allowing the rotary drill pipe to continue rotating within the sleeve at a rotation rate sufficient to conduct drilling operations in the formation;
- said internal configuration comprising longitudinally extending and circumferentially spaced apart axial grooves formed in an I.D. wall of the sleeve for allowing fluid to circulate through a space formed between the I.D. of the sleeve and the O.D. of the drill pipe;
- 20       at least one low-friction abrasion-resistant end pad formed on at least one end of the protector sleeve to reduce friction between the end of the protector sleeve and an adjacent end of the thrust bearing collar.

2.     The drilling system of claim 1 wherein the sleeve
- 30       has a low-friction abrasion-resistant end pad formed on either end of the protector sleeve.

3.     The drilling system of claim 1 wherein the end pad
- is a single piece integrally formed with the sleeve.

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4.     The drilling system of claim 1 wherein the end pad  
comprises multiple segments formed in the end of the protector  
5     sleeve.

5.     The drilling system of claim 1 wherein the end pad  
is made of ultra high molecular weight polyethylene.

10     6.     The drilling system of claim 1 wherein the end pad  
is mechanically attached to the end of the protector sleeve.

7.     The drilling system of claim 1 wherein the end pad  
has castellations formed around a perimeter of the end pad.  
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8.     The drilling system of claim 1 wherein the end pad  
is attached to a cage embedded in the protector sleeve.

9.     The drilling system of claim 1 wherein the protector  
20     sleeve has a soft elastomer liner on the I.D. of the protector  
sleeve.

10.    The drilling system of claim 1 wherein the protector  
sleeve has an O.D. including multiple distinct radius external  
25     curved surfaces.

11.    The drilling system of claim 1 wherein the O.D. of  
the protector sleeve includes at least one low-friction  
insert.  
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12.    A protective sleeve for installation around a drill  
pipe used to drill a wellbore in an underground formation, the  
protective sleeve preferentially contacting the I.D. of a well  
casing or bore when the drill pipe deflects off center in the  
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      casing or bore to protect the casing or bore from contact with  
      the drill pipe or its tool joints during rotation of the drill  
5       pipe, and which the sleeve has a generally cylindrical  
      configuration with an internal I.D. for contact with the O.D.  
      of the drill pipe wherein the sleeve is a multi-component  
      construction comprising an outer shell and a liner positioned  
      within the shell wherein the shell has a hardness in the range  
10       of 75 to 123 Rockwell R and is greater than the liner.

      13. A non-rotating drill pipe protector for use and the  
      wellbore comprising:

      a sleeve sized to be placed around a drill string;  
15       said sleeve having an I.D. having a plurality of grooves  
      for generating a fluid bearing between the I.D. and the drill  
      pipe;

      the sleeve having an O.D. including multiple distinct  
      radius external curved surfaces contoured for increasing  
20       sliding contact surface area, said contoured surfaces  
      separated by channels on the O.D.; and

      a soft elastomer liner having a hardness of 60 Shore A or  
      less on the I.D. of the sleeve.

25       14. The protector of claim 13 wherein the sleeve has at  
      least one low-friction end pad positioned on the end of the  
      sleeve.

      15. The protector of claim 14 wherein the end pad  
30       comprises multiple segments formed in the end of the sleeve.

      16. The protector of claim 14 wherein the sleeve has a  
      low-friction end pad positioned on each end of the sleeve.

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17. The protector of claim 13 wherein the sleeve has low  
friction wear pads on the O.D. of the sleeve.

5        18. The protector of claim 14 wherein the end pad is  
made of ultra high molecular weight polyethylene.

10       19. The drilling system of claim 9 wherein the liner  
comprises multiple strips positioned around the I.D. of the  
protector sleeve.

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